

## PATENT ABSTRACTS OF JAPAN

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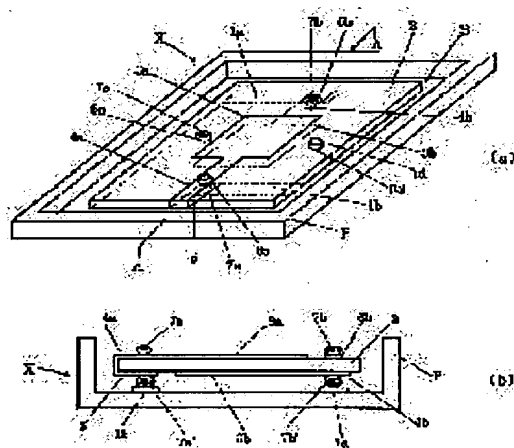
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## (54) PIEZOELECTRIC VIBRATOR

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To suppress spuriousness, even if a bonding process is eliminated by installing pads conducted with the lead electrodes of a piezoelectric substrate and conducting and fixing the corresponding pad via bumps.

**SOLUTION:** Pads 6a-6d conducted with lead electrodes 4a and 4b located at a distance from a pair of electrodes 3a and 3b on both main faces of a piezoelectric substrate 2 are formed. The lead electrodes 4b and 5 of a quartz vibration elements S are bonded to lead electrodes 1a and 1b at the base of a package P through metallic bumps 7a' and 7b'. The metal bumps 7a-7d are bonded to the pads 6a-6d. The positions and the number of the bumps are determined, so that spuriousness nearby main vibration is suppressed without affecting the intensity of a main vibration mode. Then, a position which is to hold the quartz vibration element S is determined. Thus, spuriousness can be suppressed by setting an electrode pattern without bonding the piezoelectric substrate.



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## CLAIMS

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[Claim(s)]

[Claim 1] In the piezoelectric transducer which contained in the package the piezo-electric oscillating component which formed one pair of electrodes in both the principal planes of a piezo-electric substrate The lead electrode which extends from said two electrodes, and the flowing pad are prepared on one principal plane of said piezo-electric substrate. It is what holds said piezo-electric substrate in said package by preparing this pad and a corresponding pad in the base in a package, and carrying out flow immobilization of both through a bump. The piezoelectric transducer characterized by setting up so that it may oppress spurious one which generates the location of said pad near the resonance frequency of a principal vibration.

## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention relates to the piezoelectric transducer which oppressed effectively spurious one which exists in the RF close-attendants side of resonance frequency about a piezoelectric transducer.

[0002]

[Description of the Prior Art] The quartz resonator is small, and although it is widely used by the former until it results [ from communication equipment ] in a public welfare device since the frequency of high degree of accuracy and high stability is obtained, development of small vibrator is further furthered with the request of a miniaturization of a cellular-phone terminal or a personal computer in recent years from it. Drawing 4 is the perspective view showing the structure of surface mount mold vibrator (SMD vibrator is called hereafter). While the plinth section 10 is formed in one edge of the base of Package P and a lead electrode is calcinated by this plinth section 10, the flow is aimed at in [ this lead electrode / as the external terminal of Package P ] airtight. on the other hand -- the front flesh side of the Xtal substrate 11 -- electrodes 12 and 13 are mostly formed in the center, and the lead electrodes 14 and 15 have extended

towards the edge of the Xtal substrate 11 from these electrodes 12 and 13. The end of this quartz-resonator component S is put on the plinth section 10 of Package P, and a flow is aimed at while fixing the lead electrodes 14 and 15 of the quartz-resonator component S, and the lead electrode of Package P with electroconductive glue 16 and 17. This supporting method is the so-called quartz resonator of the cantilever structure which fixes the end of the quartz-resonator component S.

[0003] The oscillation mode of an AT cut quartz resonator is thickness-slip-vibration mode as everyone knows, and much spurious (in harmonic overtone) one generates it in the high frequency close-attendants side of this principal vibration other than the principal vibration decided by the thickness of the Xtal substrate, and the mass-load effectiveness of an electrode. Even if it uses the well-known energy \*\*\*\*\* technique, it cannot oppress thoroughly, but when using this quartz resonator for a crystal oscillator, the case where it is spurious and oscillates may arise, and spurious one of these may be connected in malfunction of a device. Moreover, when using said quartz resonator for a crystal filter, spurious one arises and a filtering property is made to deteriorate remarkably in the RF close-attendants side of center frequency.

[0004] Conventionally, as a means to

oppress spurious one produced near the principal vibration of a quartz resonator, as shown in drawing 4, it was performed around the main electrode that more than one adhere the adhesion matter of electroconductive glue 18 grade etc. to one side or both sides. By adhering the matter which absorbs vibrational energy in the big location like the unnecessary oscillation mode which should be oppressed oscillating being strange, this is the approach of oppressing said oscillation mode.

[0005]

[Problem(s) to be Solved by the Invention] However, since the process of a means [ to adhere the above-mentioned adhesives etc. and to oppress spurious one ] which adheres adhesives increased, it had the problem that a manufacturing cost became high. It is made in order that this invention may solve the above-mentioned problem, and it aims at offering the vibrator which oppressed spurious one by the side of the RF close attendants of resonance frequency.

[0006]

[Means for Solving the Problem] Invention of the piezoelectric transducer built over this invention in order to attain the above-mentioned object according to claim 1 In the piezoelectric transducer which contained in the package the piezo-electric oscillating component which formed one pair of electrodes in both the principal planes of a

piezo-electric substrate. The lead electrode which extends from said electrode, and the flowing pad are prepared on said piezo-electric substrate. It is the piezoelectric transducer which prepares this pad and a corresponding pad in the base in a package, carries out flow maintenance of both through a bump, and is characterized by setting up so that it may oppress spurious ones which generates the location of said pad near the resonance frequency of a principal vibration.

[0007]

[Embodiment of the Invention] This invention is explained to a detail based on the gestalt of operation shown in the drawing below. Drawing 1 (a) and (b) are the perspective view showing the structure of the quartz resonator X concerning this invention, and a sectional view in the A-A line, and a quartz resonator X consists of Xtal components S held in Package P and its internal base. In the internal base of Package P, an external terminal and the lead electrodes 1a and 1b which flow in airtight are calcinated, and the metal for resistance welding is calcinated by the upper bed periphery of Package P. On the other hand, the quartz-resonator component S consisted of a Xtal substrate 2 and electrodes 3a and 3b formed in both the principal plane, and the lead electrodes 4a and 4b have extended toward the edge of the Xtal substrate 2, respectively from

Electrodes 3a and 3b. And one lead electrode 4a is formed so that the end face of the Xtal substrate 2 may be electrically connected with the lead electrode 5 on the rear face of the surroundings. furthermore, the metal membranes 6a, 6b, and 6c of an area small in the process that it is the same in case Electrodes 3a and 3b are formed in two or more locations decided with the means which is on the principal plane of the Xtal substrate 2, and is expressed below .. two or more -- forming -- the golden bumps 7a, 7b, and 7c of plurality [ top / it ] -- it forms by the technique of common knowledge of ..

[0008] on the other hand -- the base of Package P -- said golden bumps 7a, 7b, and 7c -- with the lead electrodes 1a and 1b in the location corresponding to .. The golden bump 7a' and lead electrodes 4b and 5 which forms 7b', put the above-mentioned Xtal oscillating component S on it, and were formed in the rear face of this Xtal oscillating component S, and the lead electrodes 1a and 1b of a package are pasted up by the well-known technique through golden bump 7a' and 7b'.

[0009] next, the golden bumps 7a and 7b -- the location on the Xtal substrate which adheres ... is explained. As shown in introduction and drawing 2 , an adhesion object etc. is adhered by the technique same on both the principal planes of the Xtal substrate 2 as usual,

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the resonance characteristic of this quartz-resonator component S is measured, and it asks for a frequency and spurious magnitude. That is, it asks for the relation between the adhesion location of an affix, and spurious magnitude by experiment beforehand.

[0010] At this time, it is important not to influence the reinforcement of desired principal mode of vibration as effectiveness of an affix, but to oppress spurious one near the principal vibration. The adhesion location with which it is satisfied of such conditions out of much experiments is found out, and the location and number which adhere a golden bump are decided. If resonance frequency and the magnitude 3a and 3b of an electrode are set up, a golden bump's location and the number which oppress spurious one effectively based on the above-mentioned sample are chosen, two locations which should hold the quartz-resonator component S from the inside will be determined, and the pattern of the extending lead electrode and a pad will be decided. Thus, the electrode pattern which forms an electrode, a lead electrode, a pad, and the thin film for golden bump adhesion will be determined, and an electrode pattern can be designed.

[0011] Although it is other examples, and formation of the lead electrode in a substrate end face is needed in order to wire an underside side in the electrode by

the side of a top face like the example of drawing 1, in order to use approaches, such as slanting vacuum evaporation, while a process becomes complicated, it may become imperfect electric flowing drawing 3 in an end face. While being the location where the oppression effectiveness spurious in the above-mentioned experiment was checked as a means to cancel this, the hole which penetrates a substrate table flesh side in the location near the edge of the Xtal substrate is dug, carry out metallizing of this hole, and let a flow of a table rear face be a secured plug.

[0012] Although the case where the above-mentioned explanation applied this invention to a quartz resonator using the Xtal substrate was explained, it is not necessary to say that it is applicable to piezoelectric material, such as other piezoelectric material, langasite, lithium tantalate, tantalic acid,  $\text{NaIOBEITO}$ , and lithium tetraborate, without limiting this invention to a quartz resonator. moreover, the spurious oscillation which generates near the principal vibration using vibration analysis, such as the finite element method, although the above-mentioned explanation explained the technique of asking for a golden bump's location by experiment -- if the technique which asks at least for it being strange two-dimensional, makes the greatest location like those oscillating strange a golden bump location, and is

checked in an experiment uses, it is possible to reduce the count of an experiment substantially

[0013]

[Effect of the Invention] This invention is \*\*\*\* about the outstanding effectiveness that it is possible to oppress substantially spurious ones generated in the RF close-attendants side of main resonant frequency while fixing a piezo-electric oscillating component to a package since it constituted as explained above.

#### DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The perspective view of the piezoelectric transducer which (a) requires for this invention, and (b) are drawings showing the cross section in A-A.

[Drawing 2] It is drawing explaining the vibrator component for deciding a golden bump's adhesion location.

[Drawing 3] It is drawing showing the cross section of the piezoelectric transducer which connected the lead electrode of a front flesh side through the breakthrough in other examples of this invention.

[Drawing 4] It is the perspective view showing the structure of the conventional surface mount mold quartz resonator.

[Description of Notations]

A .. Cutting plane line

P .. Package

X .. Piezoelectric transducer

1a, 1b .. Lead electrode of a package

2 .. Piezo-electric substrate

3a, 3b .. Electrode

4a, 4b, 5 .. Lead electrode

6a, 6b, 6c, 6d, 6e, 6f .. Vacuum evaporation film

7a, 7a', 7b, 7b', 7c, 7d, 7e, 7f .. Golden bump

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